Waheeb



Armed Forces College of Medicine

AFCM

Waheeb



DEVELOPMENT OF HEAD AND NECK 1

DEVELOPMENT OF BRANCHIAL] [(PHARYNGEAL) APPARATUS

Dr. Mervat Thabet

Prof. Of Anatomy & Embryology

INTENDED LEARNING OBJECTIVES (ILO)

By the end of this lecture the student will be able to:

1. Identify the basic structure of the branchial (pharyngeal) arches.
2. Discuss the derivatives of the branchial (pharyngeal) arches (mesodermal derivatives).
3. Comment on the derivatives of the branchial (pharyngeal) pouches (endodermal derivatives).
4. Give a note on the derivatives of the branchial (pharyngeal) clefts (ectodermal derivatives).
5. Explain the congenital anomalies of the branchial (pharyngeal) apparatus.

Waheeb

Lecture Plan



1. Part 1 (5 min) Introduction
2. Part 2 (40 min) Main lecture
3. Part 3 (5 min) Summary

Waheeb

Key points



1. 4 components of branchial (pharyngeal) apparatus
2. Pharyngeal arches, components & derivatives
3. Pharyngeal pouches & their derivatives
4. Congenital anomalies of pharyngeal apparatus

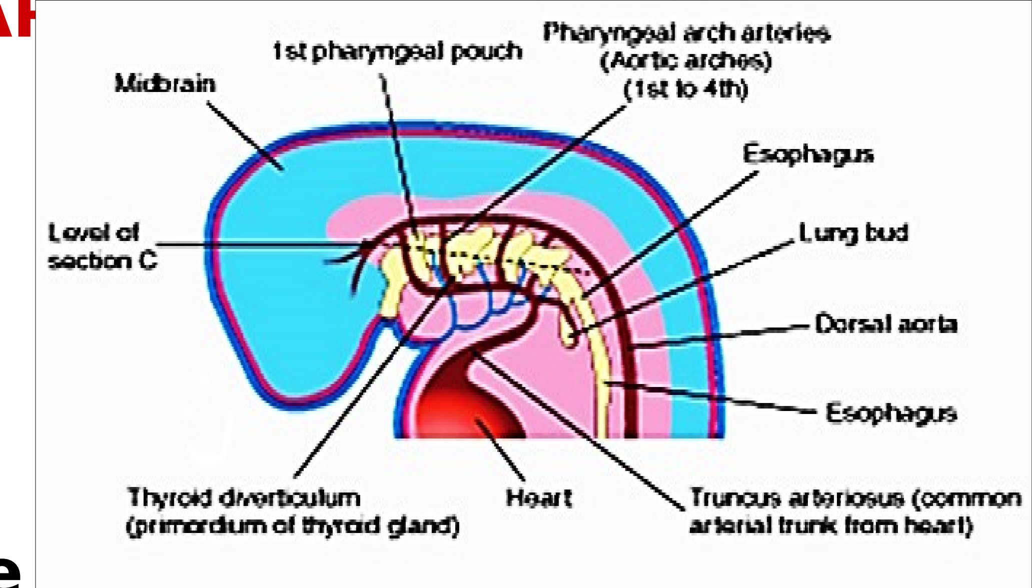
Waheeb



PHARYNGEAL (BRANCHIAL) APPARATUS

Waheeb

The pharyngeal arches begin to develop in the lateral walls of the primordial pharynx during 4th week in the form of 6 curved cylindrical mesodermal thickenings on each side of the primitive pharynx.

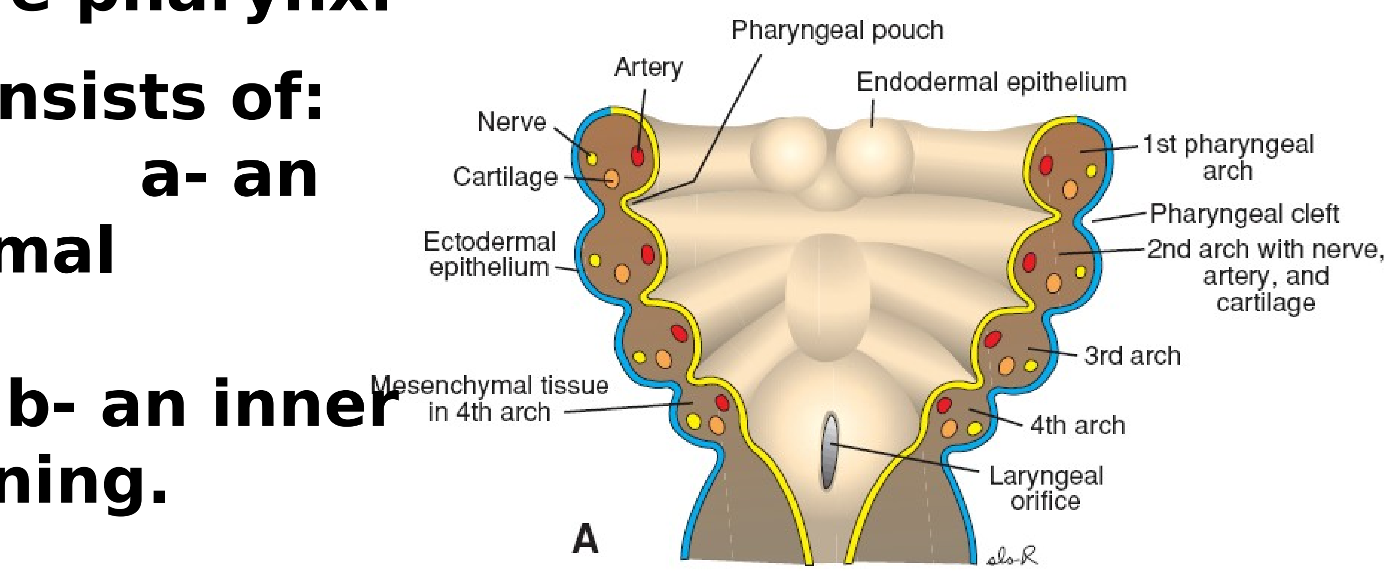


- Each arch consists of:

a- an outer ectodermal covering.

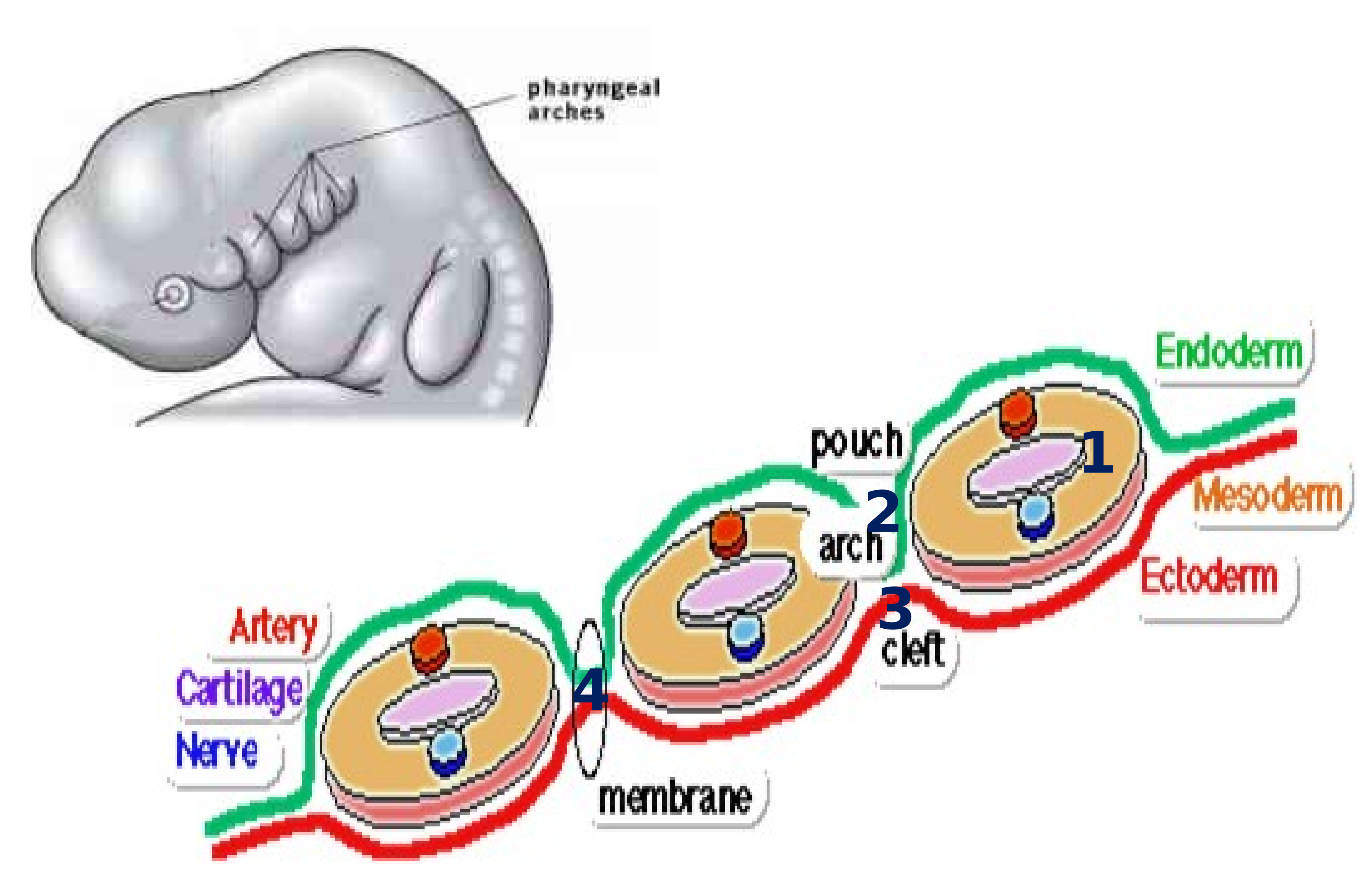
b- an inner endodermal lining.

c- a mesodermal core



Waheeb

Branchial (pharyngeal) apparatus

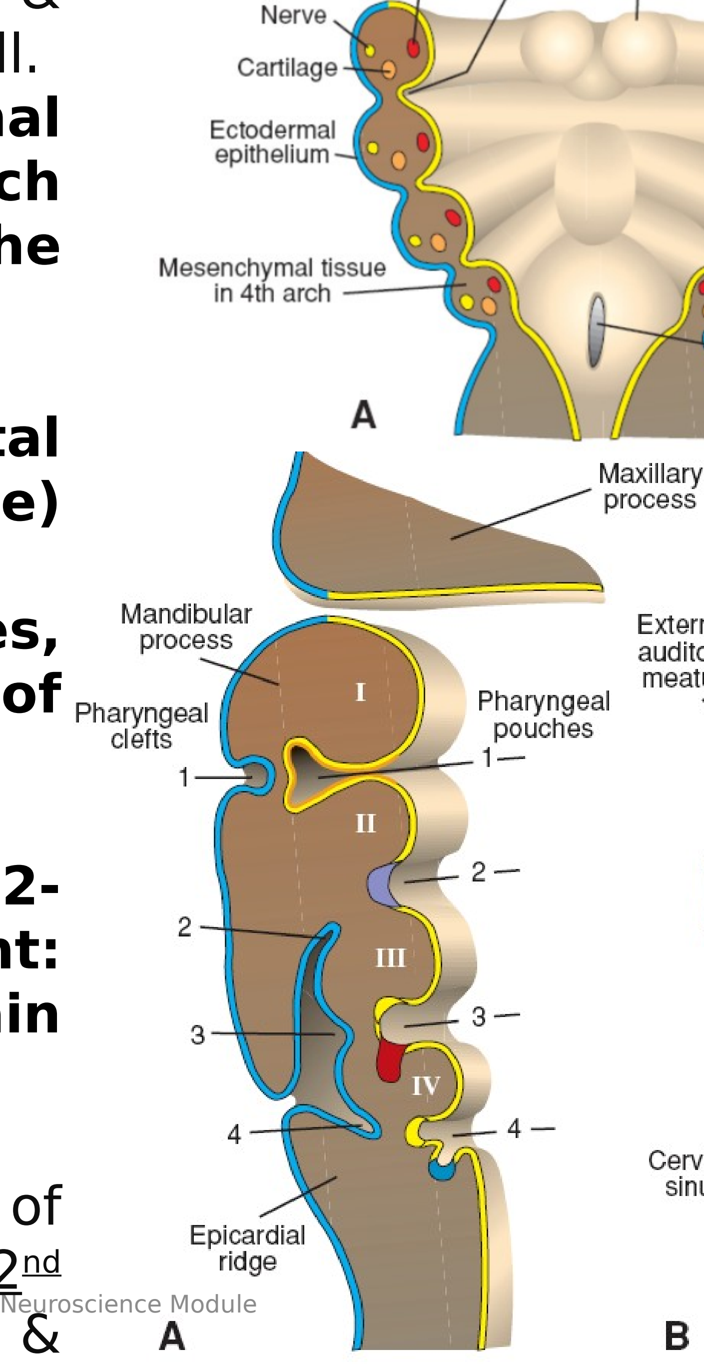


Waheeb

- 5th arch disappears early & 6th arch becomes very small.
- **The mesodermal component of each arch differentiates into the following components:**

1- Skeletal element: (arch cartilage) which differentiates into certain cartilages, ligaments and bones of head and neck.

2- Muscular element: differentiates into certain muscles..

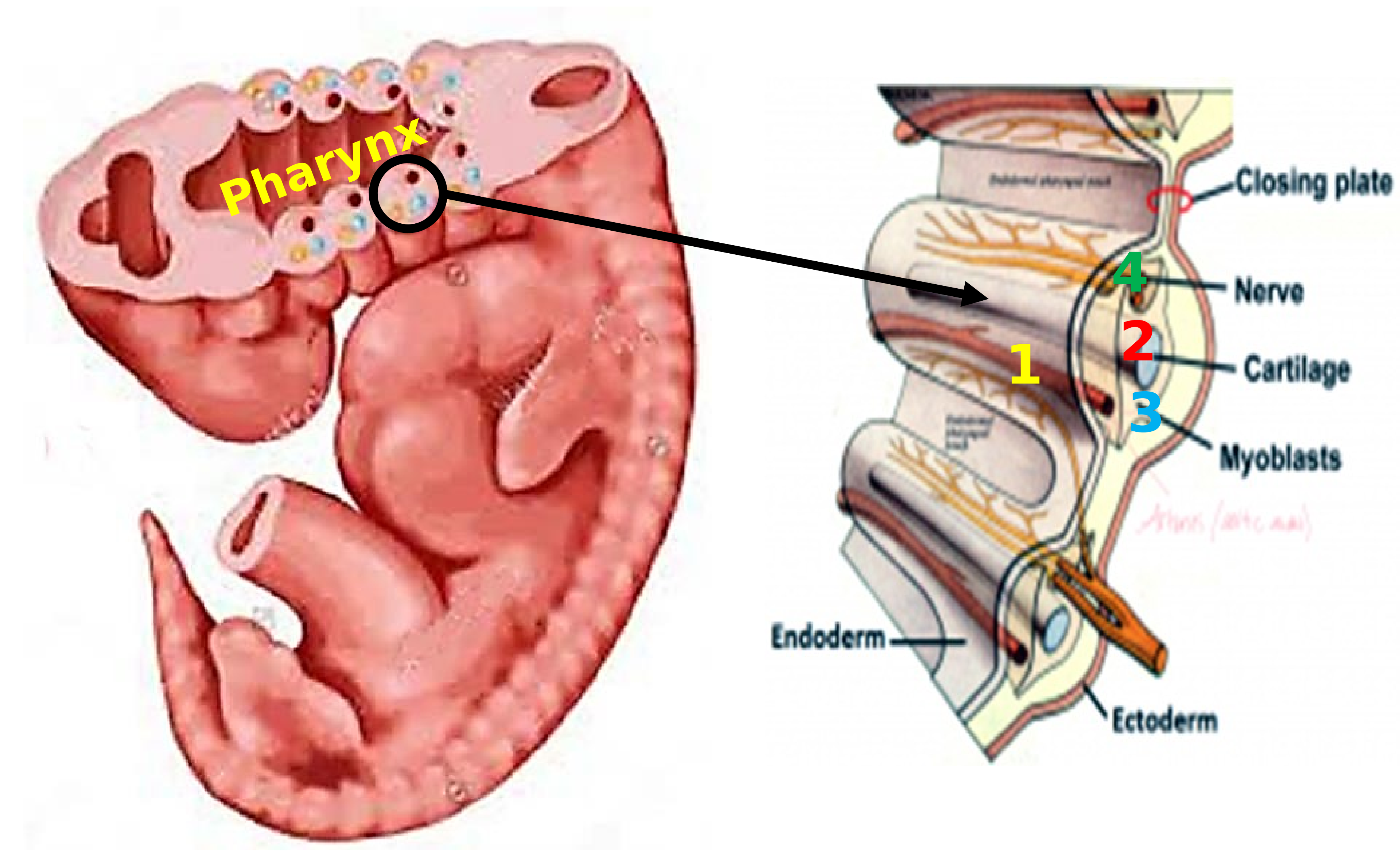




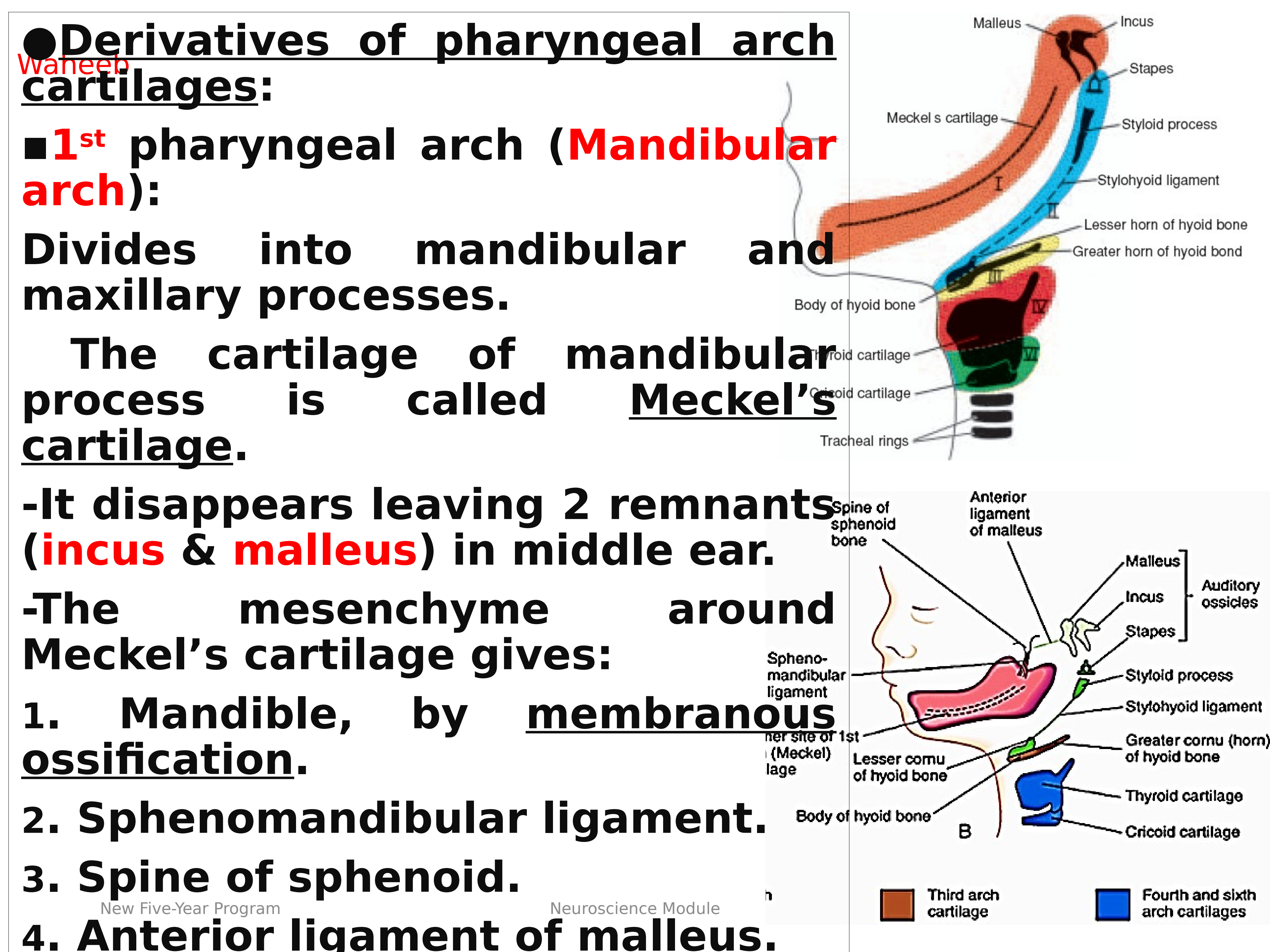
▪During 5th week of development, the 2nd pharyngeal arch enlarges &

Waheeb

Components of pharyngeal arches

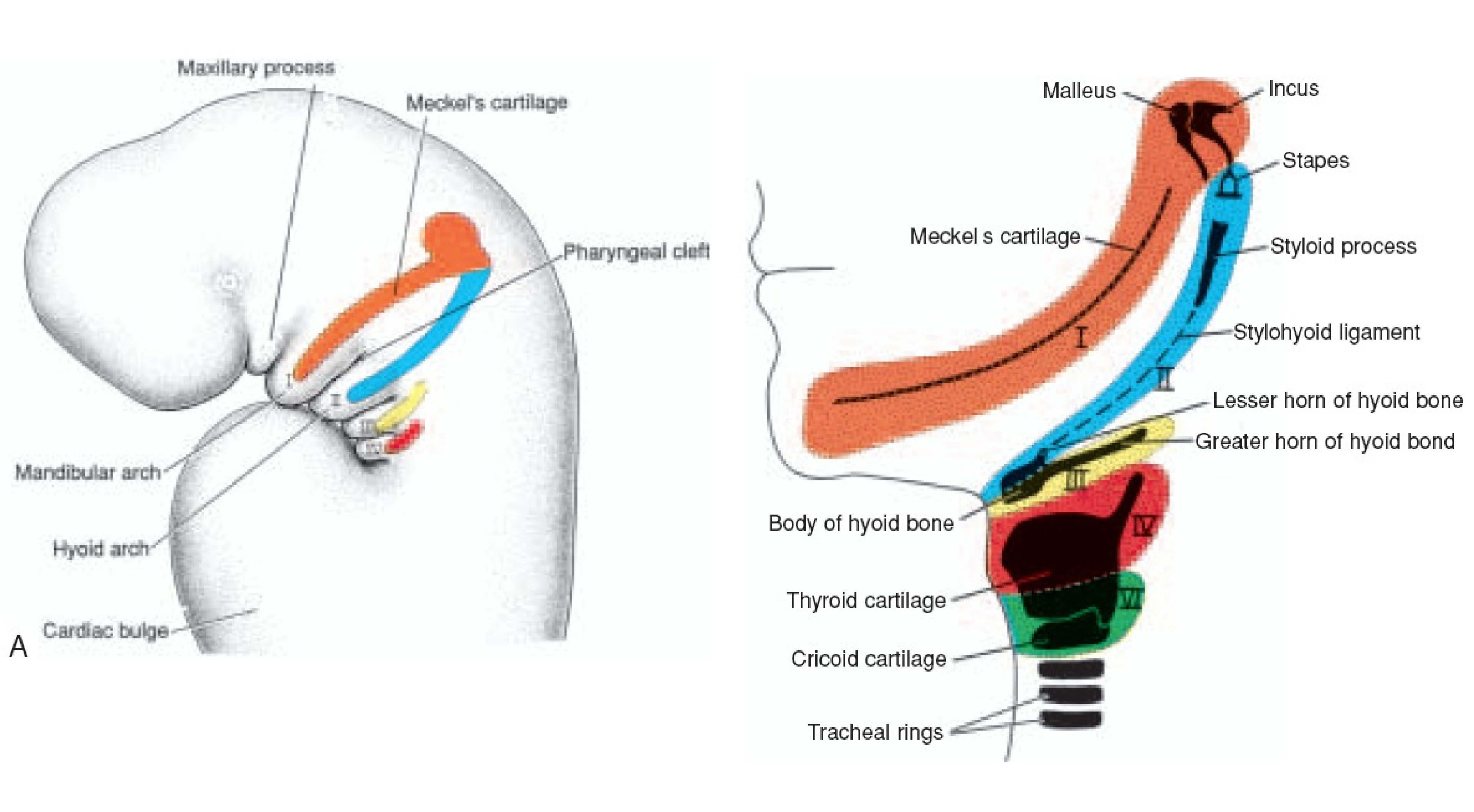


The 5 facial prominences



Waheeb
●Derivatives of pharyngeal arch cartilages:
■1st pharyngeal arch (Mandibular arch):
Divides into mandibular and maxillary processes.
The cartilage of mandibular process is called Meckel's cartilage.
-It disappears leaving 2 remnants (incus & malleus) in middle ear.
-The mesenchyme around Meckel's cartilage gives:
1. Mandible, by membranous ossification.
2. Sphenomandibular ligament.
3. Spine of sphenoid.
4. Anterior ligament of malleus.
Malleus
Incus
Stapes
Meckel s cartilage
Styloid process
Stylohyoid ligament
Lesser horn of hyoid bone
Greater horn of hyoid bond
Body of hyoid bone
Thyroid cartilage
Cricoid cartilage
Tracheal rings
I
II
III
IV
VI
Spine of sphenoid bone
Anterior ligament of malleus
Malleus
Incus
Stapes
Auditory ossicles
Spheno-mandibular ligament
Styloid process
Stylohyoid ligament
Greater cornu (horn) of hyoid bone
Lesser cornu of hyoid bone
Thyroid cartilage
Body of hyoid bone
Cricoid cartilage
B
Third arch cartilage
Fourth and sixth arch cartilages
New Five-Year Program
Neuroscience Module

Waheeb



Maxillary process
Meckel's cartilage
Pharyngeal cleft
Mandibular arch
Hyoid arch
Cardiac bulge
A
Malleus
Incus
Stapes
Meckel s cartilage
Styloid process
Stylohyoid ligament
Lesser horn of hyoid bone
Greater horn of hyoid bond
Body of hyoid bone
Thyroid cartilage
Cricoid cartilage
Tracheal rings

■ **2nd pharyngeal arch (Hyoid arch): Its cartilage is called Reichert's cartilage. It gives:**

1. **Stapes.**
2. **Styloid process.**
3. **Stylohyoid ligament.**
4. **Lesser cornu & upper part of the body of hyoid bone.**

1st arch (Meckel) cartilage
Site of developing internal ear
2nd arch (Reichert) cartilage
A
Spine of sphenoid bone
Anterior ligament of malleus
Malleus
Incus
Stapes
Auditory ossicles
Spheno-mandibular ligament
Styloid process
Stylohyoid ligament
1st Arch
2nd Arch
Former site of 1st arch (Meckel) cartilage
Lesser cornu of hyoid bone
Greater cornu (horn) of hyoid bone
Thyroid cartilage
Body of hyoid bone
Cricoid cartilage
B

Keith L. Moore: Before we are born, 7th edition

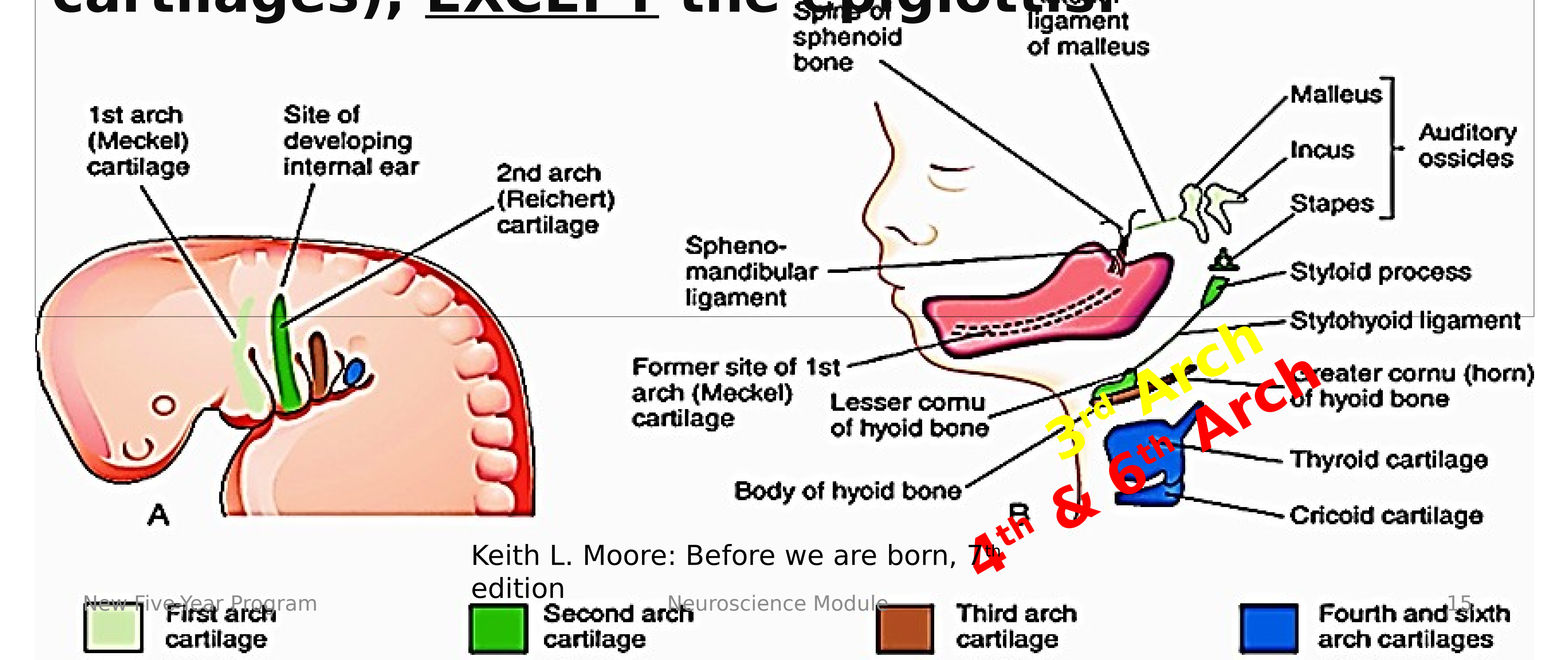
First arch cartilage
Second arch cartilage
Third arch cartilage



Waheeb

■3rd pharyngeal arch: Its cartilage ossifies to form the greater cornu & inferior part of the body of the hyoid bone.

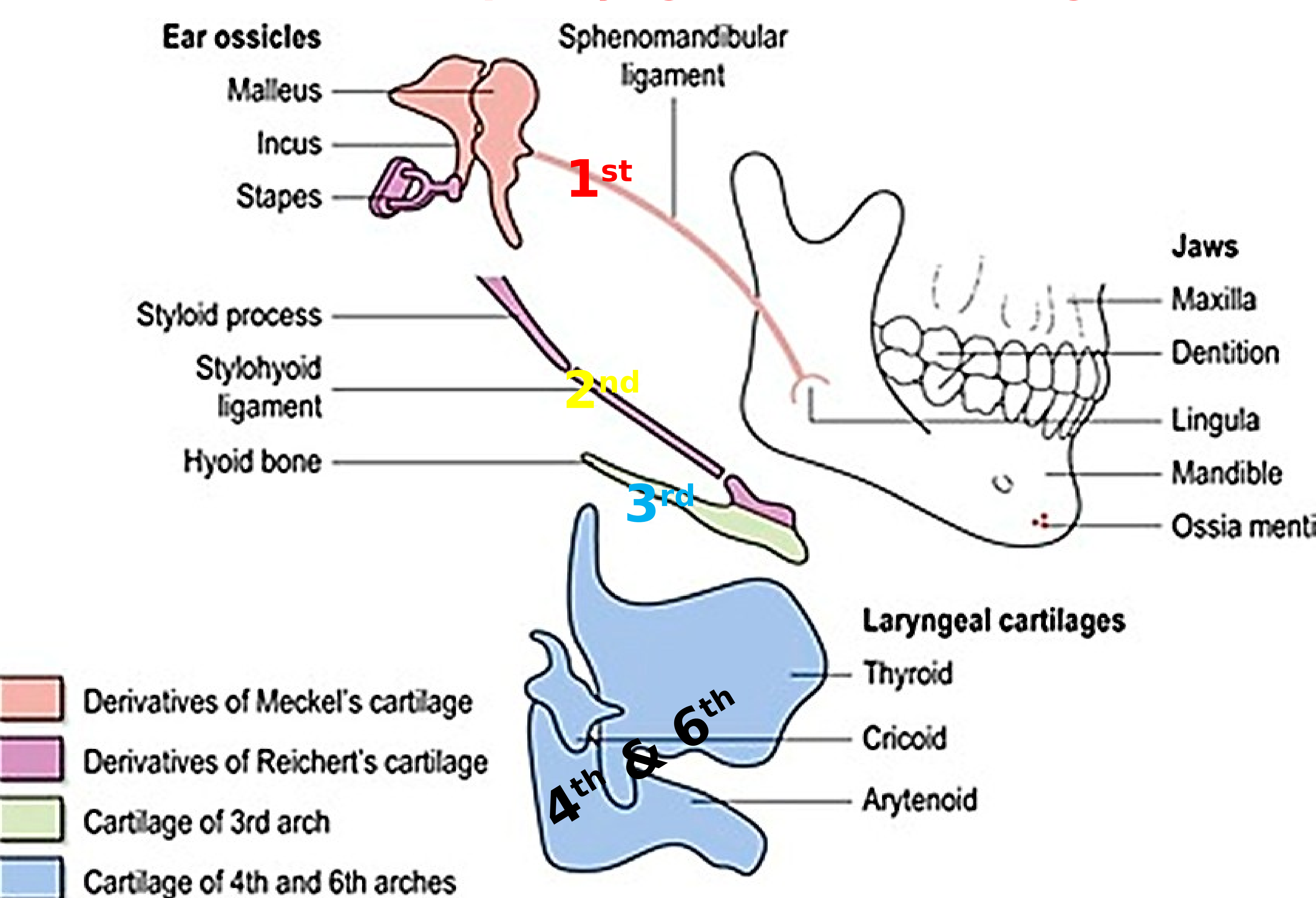
■4th & 6th pharyngeal arch cartilages: They fuse (as the 5th arch disappears) to form all laryngeal cartilages (e.g. thyroid & cricoid cartilages), EXCEPT the epiglottis.



Keith L. Moore: Before we are born, 7th edition

Derivatives of pharyngeal arch cartilages

Waheeb



●**Derivatives of pharyngeal arch muscles**:

-1st pharyngeal arch → Muscles of mastication (4) + 4 other muscles: 2 tensor (palati & tympani) and 2 adjacent muscles (mylohyoid & anterior belly of digastric).

-2nd pharyngeal arch → Muscles of facial expression + 4 other muscles: Stapedius (in middle ear), platysma and 2 adjacent muscles (stylohyoid & posterior belly of digastric).

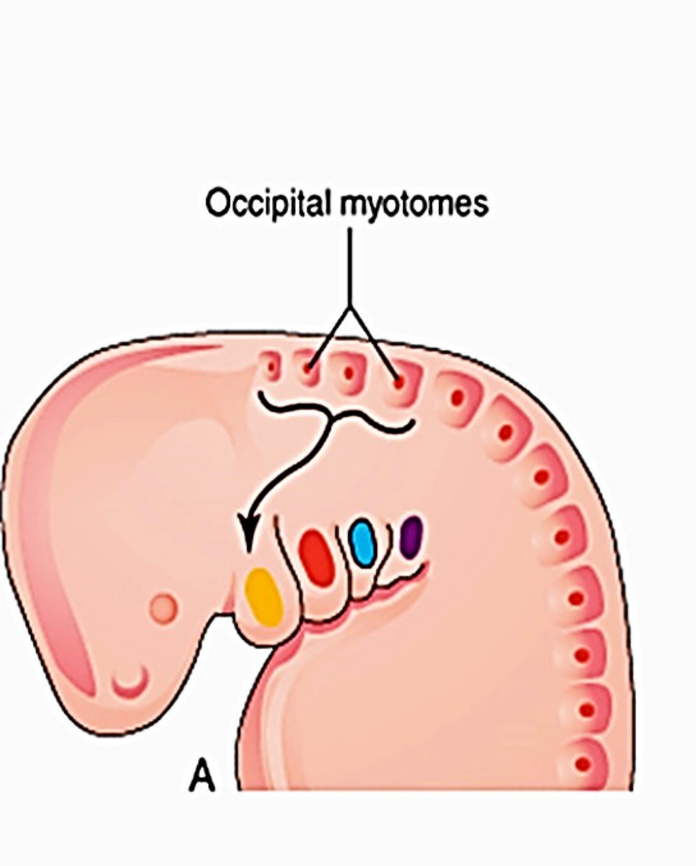
-3rd pharyngeal arch → Only one muscle (Stylopharyngeus muscle).

-4th pharyngeal arch → *Cricothyroid* - Pharyngeal constrictors – Levator palati.

-6th pharyngeal arch → All muscles of the larynx EXCEPT cricothyroid muscle.

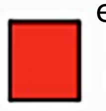
Waheeb

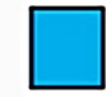
Derivatives of pharyngeal arch muscles



Keith L. Moore: Before we are born, 7th edition


First arch muscles


Second arch muscles


Third arch muscles


Fourth and sixth arch muscles

Waheeb

●**<u>Nerve supply of pharyngeal arches</u>:** ***5 – 7 – 9 – 10 & 11 [1975]***

.Each arch is supplied by a cranial nerve (CN) which supplies the muscles derived from this arch *(Motor):*

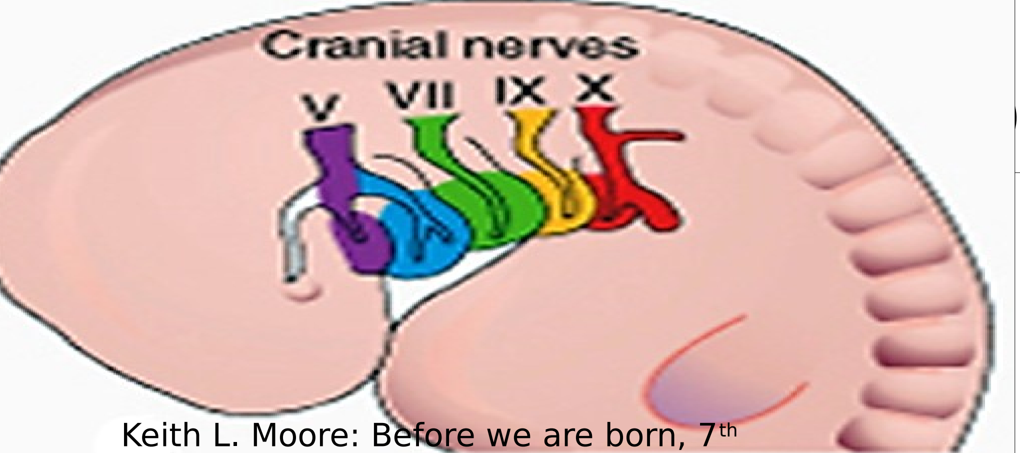
-1st pharyngeal arch → Mandibular division of trigeminal N. *5*

-2nd pharyngeal arch → Facial N. *7*

-3rd pharyngeal arch → Glossopharyngeal N. *9*

-4th pharyngeal arch → Superior laryngeal branch of vagus nerve. *10 (+ 11th CN)*

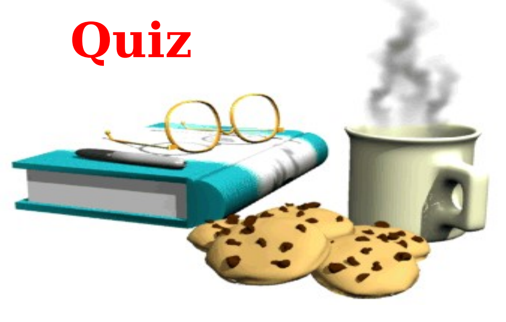
-6th pha… laryngeal branch o…)



Keith L. Moore: Before we are born, 7th

Waheeb

Quiz



■**Mention <u>true</u> each statement regarding dev of pharyngeal apparatus:**

a. 1st pharyngeal arch is innervated by trigeminal nerve.

b. Vagus nerve innervates both 4th & 6th arches.

c. Temporalis & buccinator develop from 2nd pharyngeal arch.

d. Cervical sinus is formed by 1st, 2nd & 3rd pharyngeal clefts.

T – T – F – F

■**What are the muscular derivatives of both 1st & 3rd pharyngeal arches?**

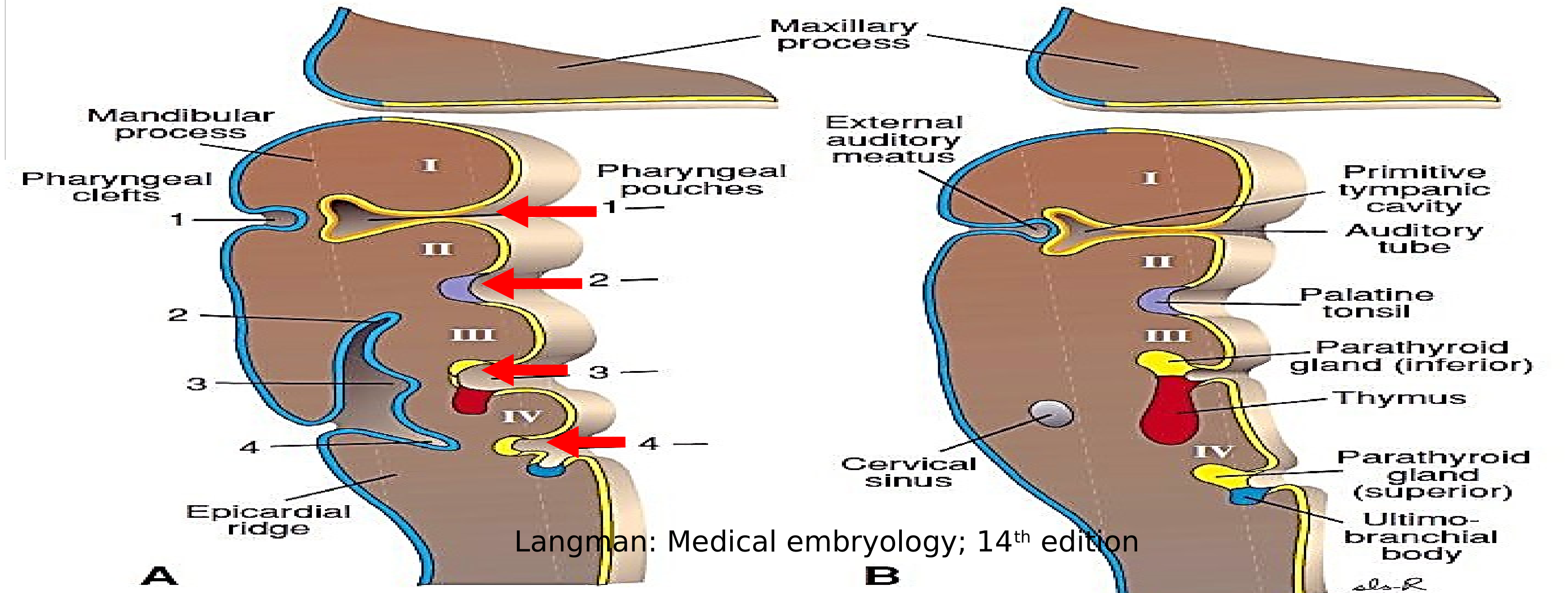
Waheeb

♣Pharyngeal pouches: _**4**_

-The endoderm of primordial pharynx lines the inner aspect of the pharyngeal arches & passes into diverticula known as the <u>pharyngeal pouches</u>.

.The pharyngeal pouches lie in-between the pharyngeal arches (e.g. 1st pouch lie between 1st & 2nd arches).

.4 pairs of pharyngeal pouches are well



Langman: Medical embryology; 14th edition

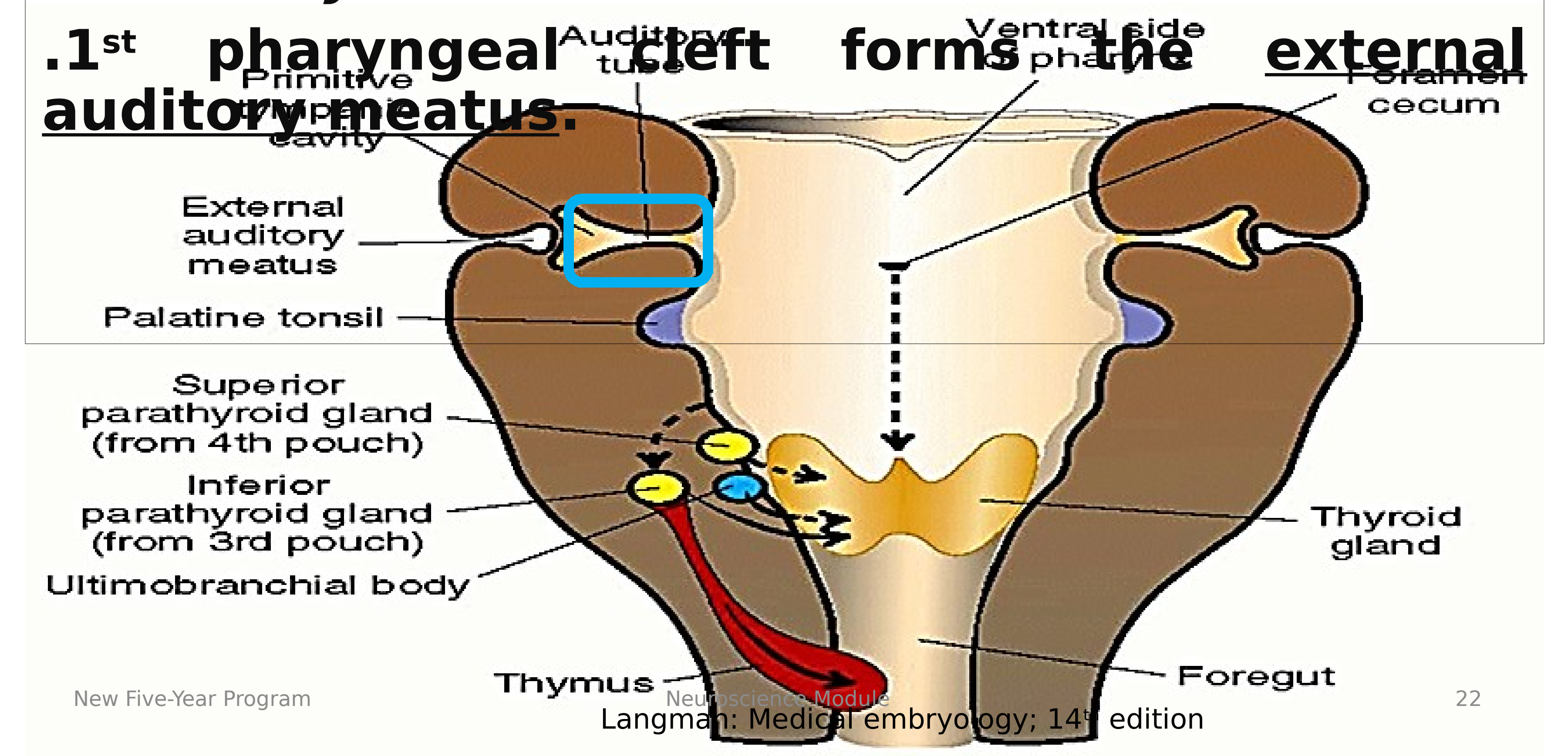
Waheeb

●Derivatives of pharyngeal pouches:

-1st pouch → Tympanic cavity (middle ear) & auditory tube.

.The 1st pharyngeal membrane forms the tympanic membrane (eardrum). ***Thin layer of mesenchyme***

.1st pharyngeal cleft forms the external auditory meatus.



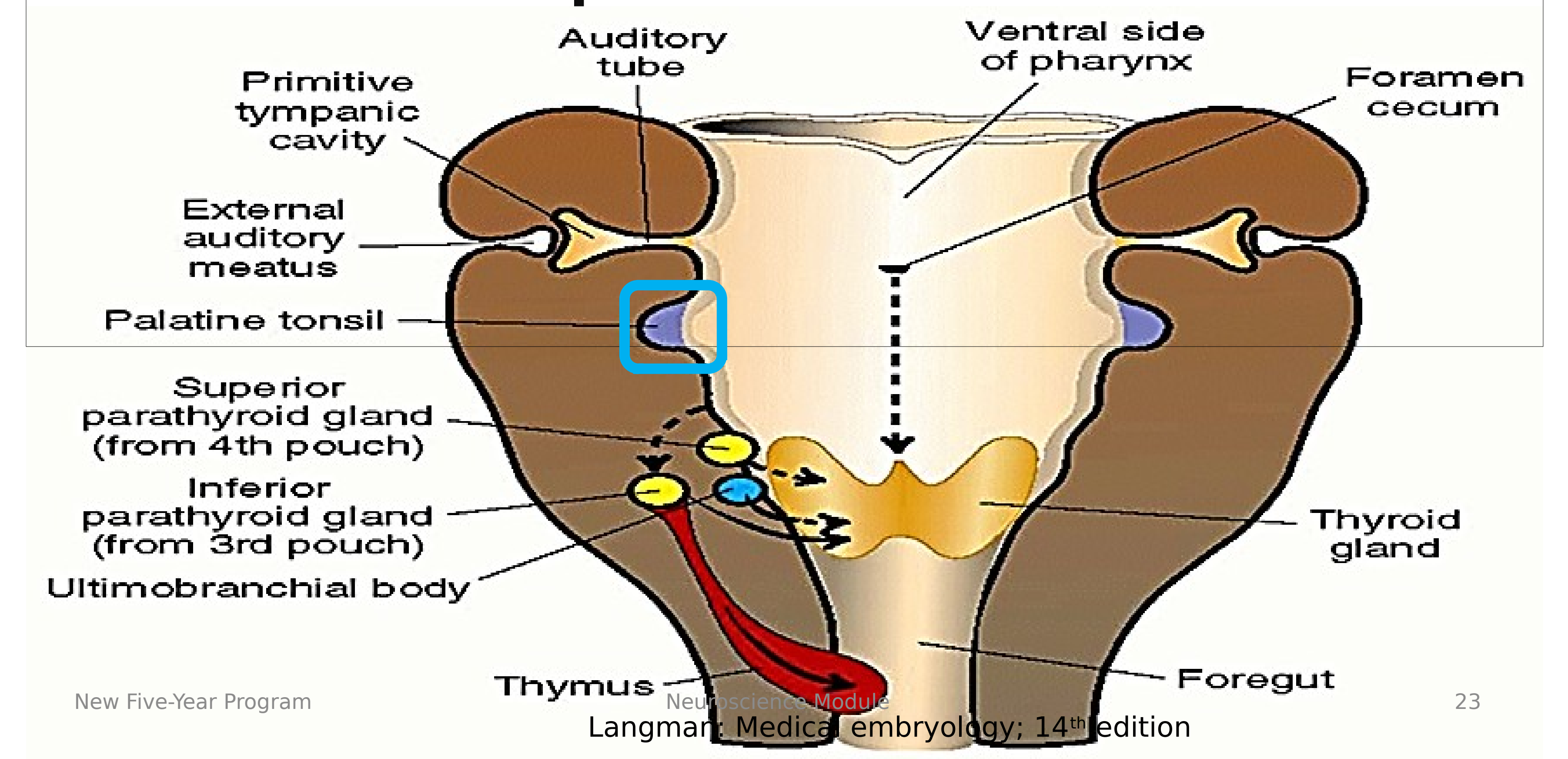
Langman: Medical embryology; 14th edition

Waheeb

-2nd pouch → Palatine tonsil.

.The endoderm gives tonsillar sinus & crypts while, surrounding mesenchyme forms the lymphoid tissue.

◆Both 3rd & 4th pharyngeal pouches divide into dorsal & ventral parts.



Langman: Medical embryology; 14th edition

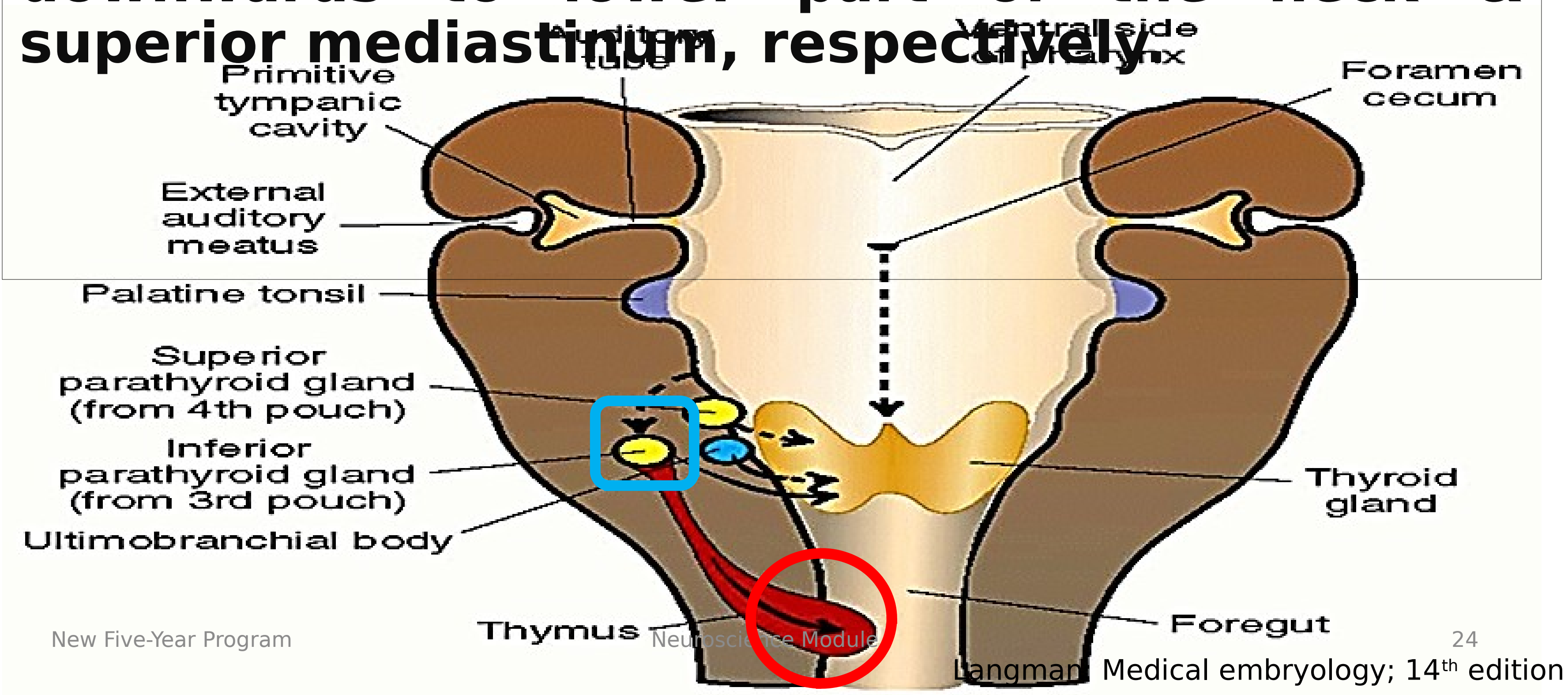
Waheeb

-3rd pouch:

.Dorsal part → <u>Inferior</u> parathyroid glands (parathyroid III)

.Ventral part → Thymus gland.

-Both lose their connections with the pharynx, separate from each other & migrate downwards to lower part of the neck & superior mediastinum, respectively.



Langman: Medical embryology; 14th edition

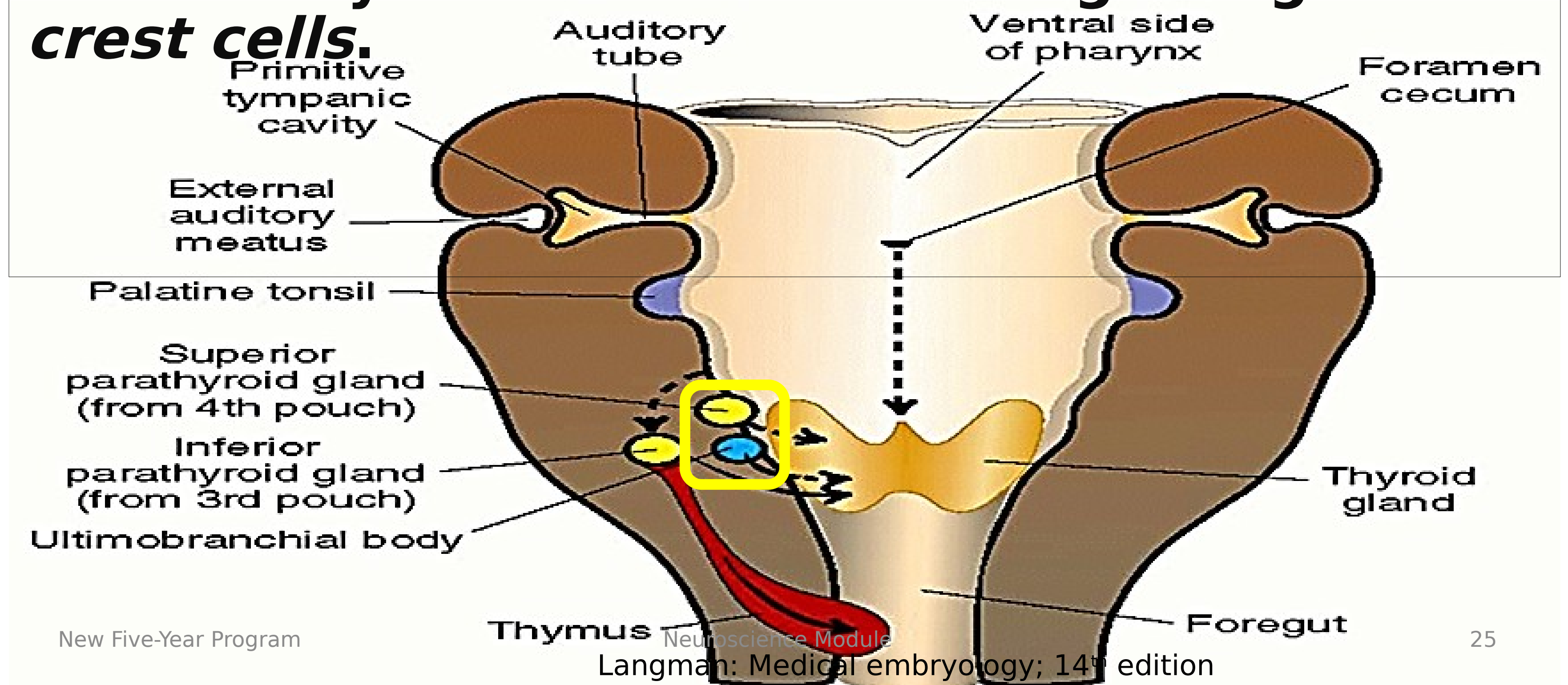
Waheeb

-**4th pouch**:

.Dorsal part → <u>Superior</u> parathyroid glands (parathyroid IV)

.Ventral part → Parafollicular C cells of thyroid gland.

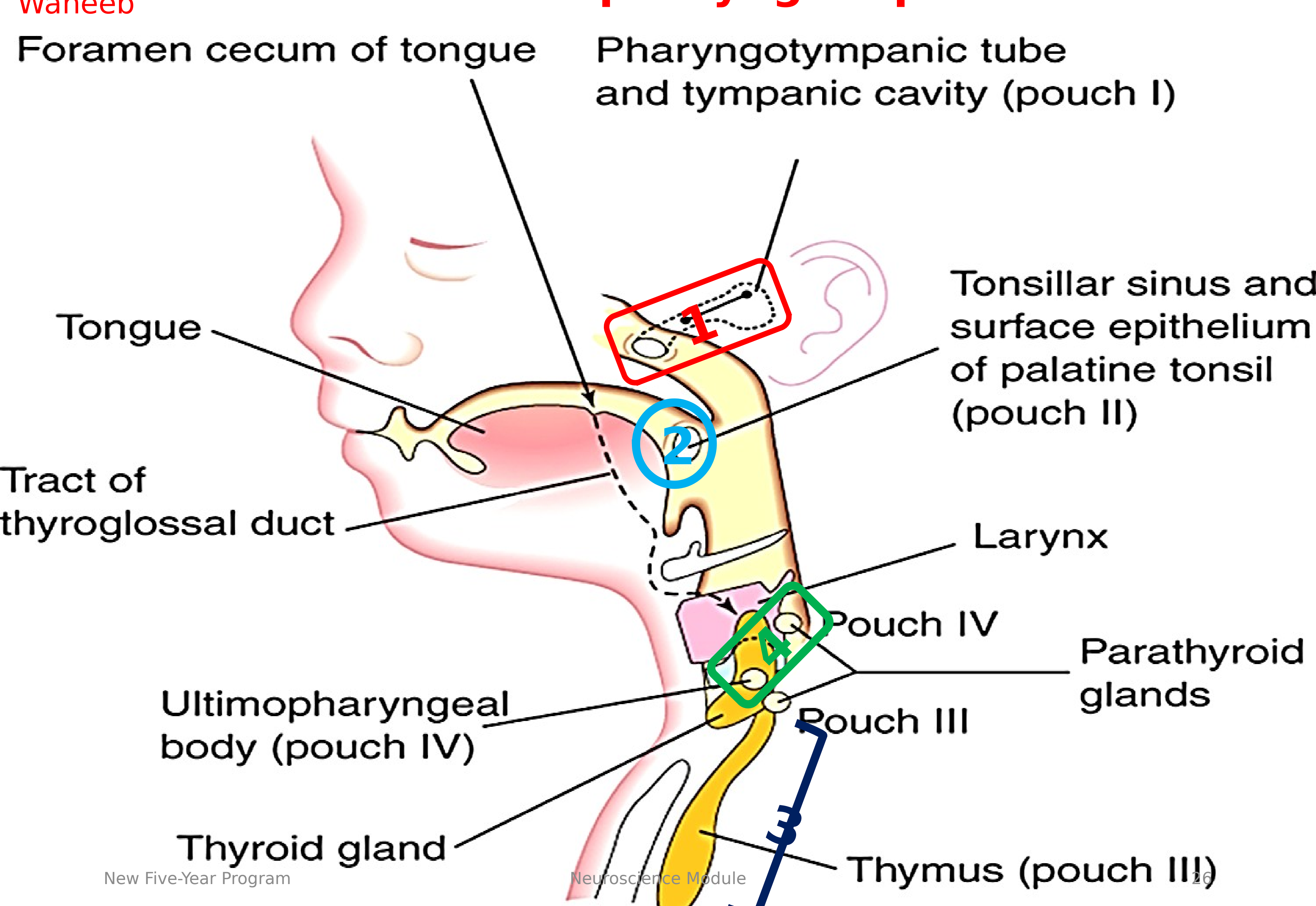
-C cells secrete calcitonin to regulate blood Ca level. They are derived from migrating *neural crest cells*.



Langman: Medical embryology; 14th edition

Derivatives of pharyngeal pouches

Waheeb



Waheeb

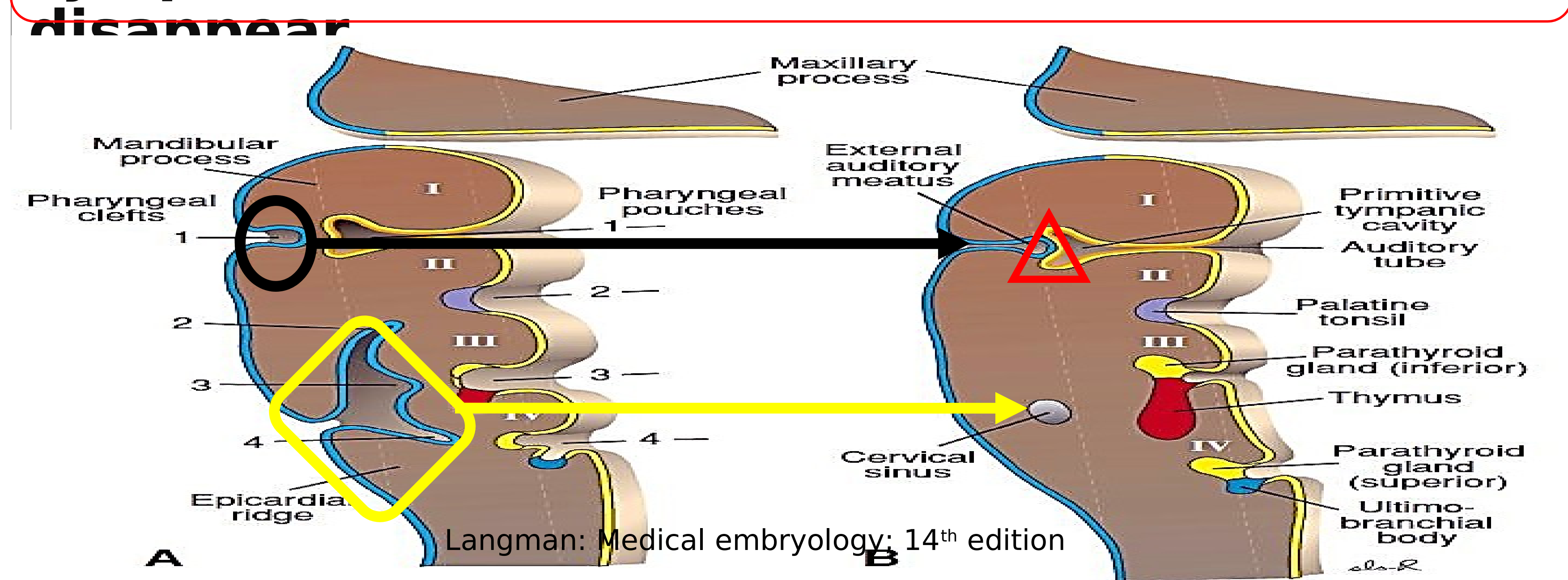
♣Pharyngeal grooves or clefts: ***4***

-4 pairs of <u>ectodermal</u> grooves that separate the pharyngeal arches externally.

.Only 1st cleft persists to form the external acoustic meatus on each side.

.Other clefts ⇒ Lie within cervical sinus which disappears at 7th week.

◆Only 1st pharyngeal membrane persists ⇒ Tympanic membrane. Other membranes disappear



Langman: Medical embryology; 14th edition

Waheeb

Quiz

- **Mention true or false for each statement regarding development of pharyngeal apparatus:**

a. Inferior parathyroid gland develops from 3rd pharyngeal pouch.

b. Tympanic membrane develops from 1st pharyngeal cleft

T – F

- **Tympanic cavity develops from:**

a. 1st pharyngeal pouch

b. 2nd pharyngeal arch

c. 1st pharyngeal cleft

d. 3rd pharyngeal arch

e. 3rd pharyngeal pouch

Waheeb

Congenital anomalies of pharyngeal apparatus

1- Auricular pits & cysts: Anterior to the auricle.

-These are remnants of the 1st pharyngeal groove.

2-Branchial (lateral cervical) sinuses, cysts & fistula.

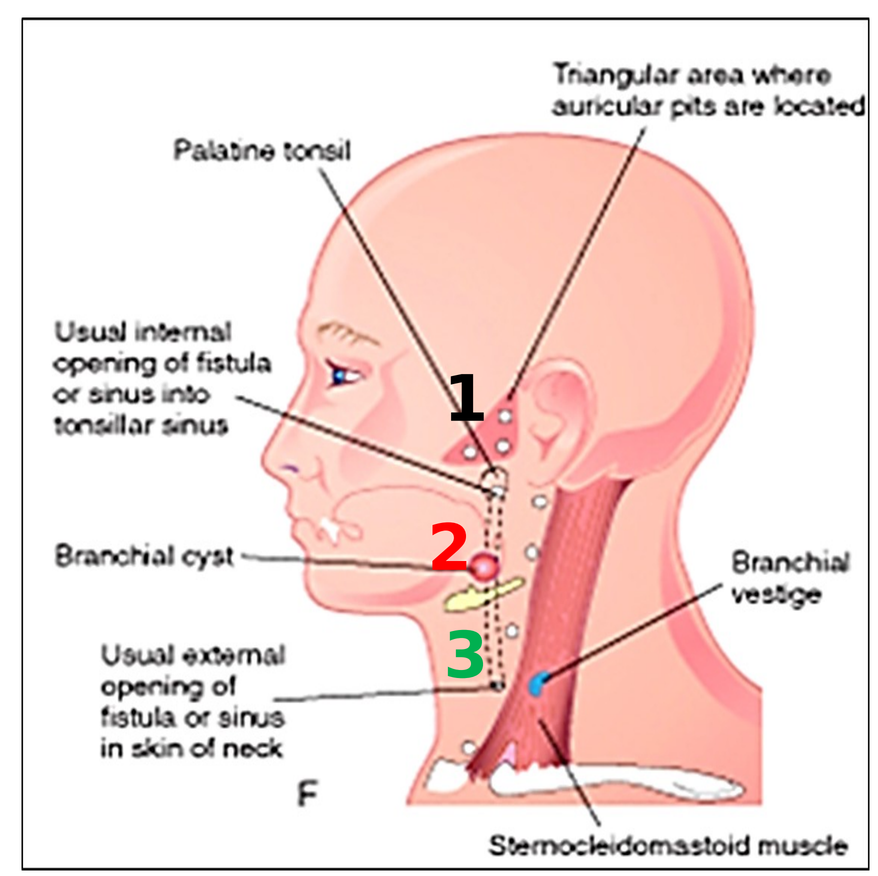
- results from failure of the cervical sinus to obliterate.

-They open on the side of the neck, along the anterior border of the sternocleidomastoid muscle in inferior 1/3 of the neck.

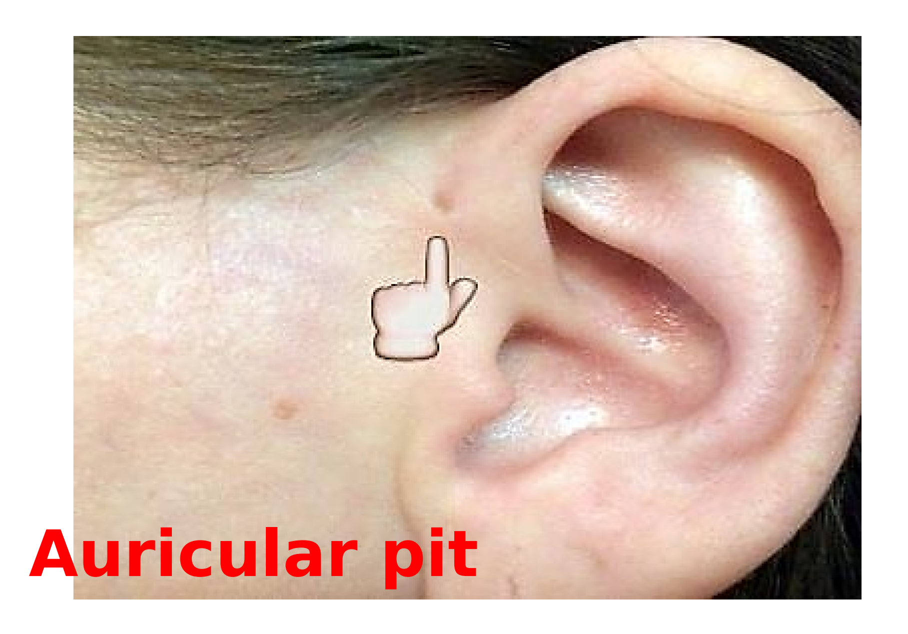
-Branchial or lateral cervical cysts are slowly enlarged, painless swelling on the side of the neck.

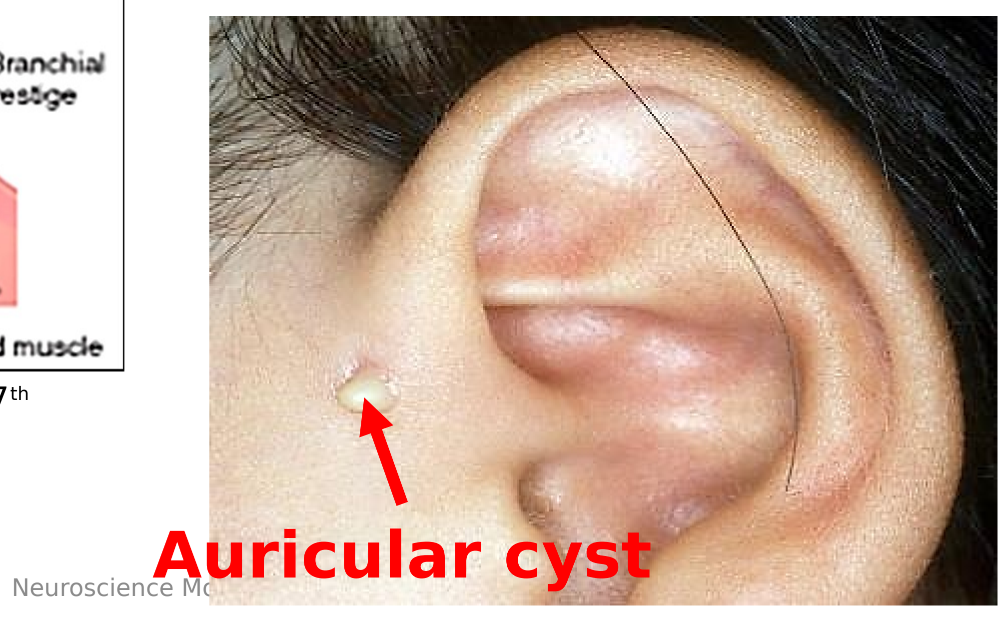
Waheeb

Anomalies of pharyngeal apparatus



Keith L. Moore: Before we are born, 7th edition





Waheeb

Branchial (lateral cervical) cyst & fistula

Branchial cyst

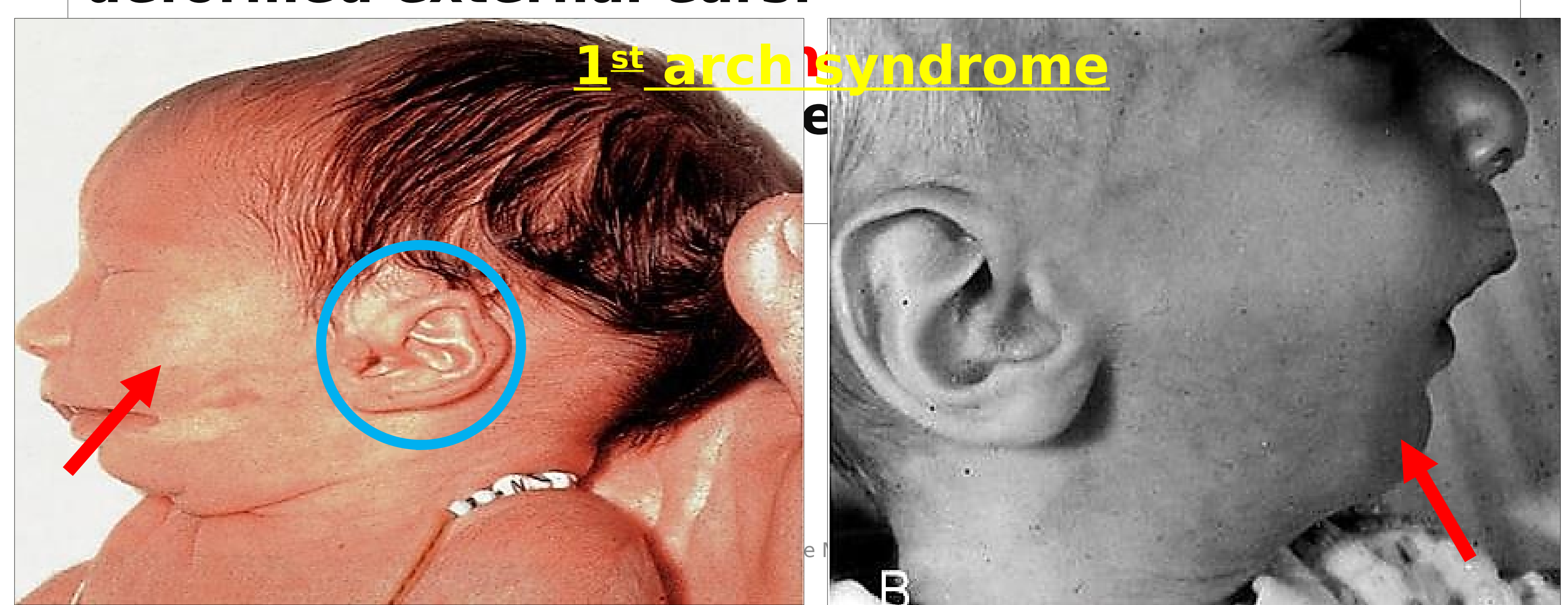
Branchial fistula

Waheeb

3. **Ectopic parathyroid**: **Inferior parathyroid my descend into thorax with thymus.**

4. **1st arch syndromes: These syndromes result from insufficient migration of neural crest cells into 1st arch.**

.Treacher Collins syndrome: Malar hypoplasia (under development of zygomatic bone) & deformed external ears.



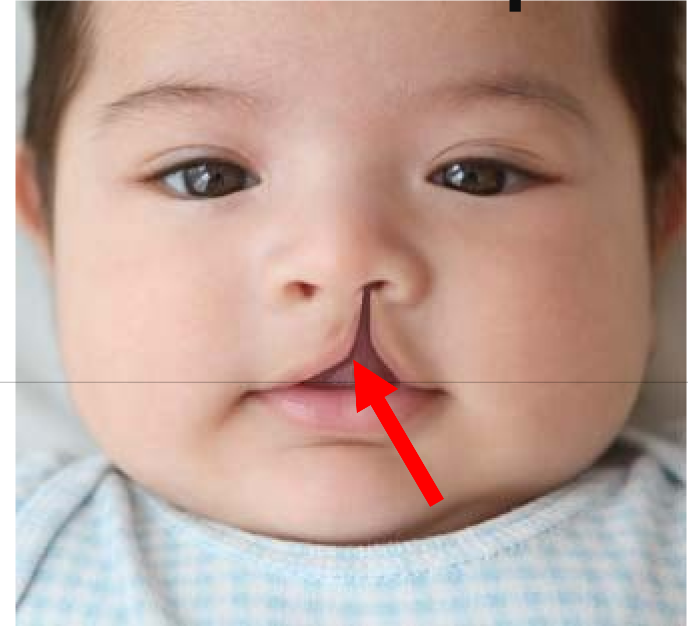
5.DiGeorge syndrome (3rd & 4th pharyngeal pouches syndrome):

-Absence of thymus & parathyroids. *Immune deficiency & ↓ Ca*

-Anomalies of the heart.

-Facial defects as fish mouth & cleft lip.





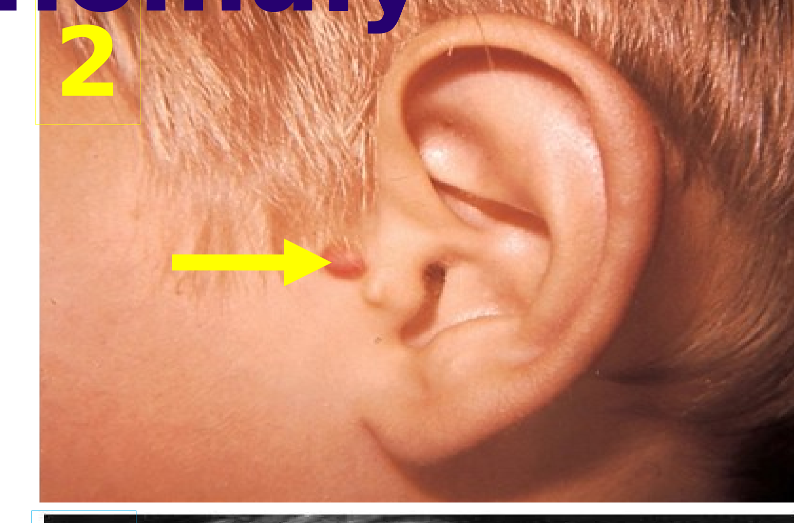
DiGeorge syndrome

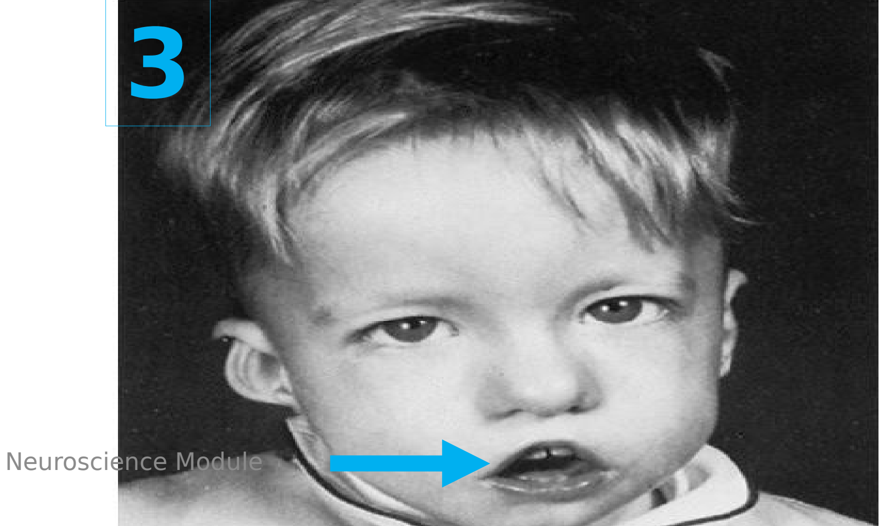
Waheeb

Identify the anomaly

Quiz







Waheeb

Lecture Summary





branchial (pharyngeal) apparatus

- **4 components:** ⇒ **Development of head & neck**

1.*Pharyngeal arches. Mesodermal → 6*

2.Pharyngeal pouches. Endodermal → 4

3.Pharyngeal clefts (grooves). Ectodermal → 4

4.Pharyngeal membranes. → 4

-Each pharyngeal arch has 4 components: A C M N

- Nerve supply of pharyngeal arches: 1975

Remember derivatives of pharyngeal arches, pharyngeal pouches, membranes & clefts. ***Very important***

Remember congenital anomalies of pharyngeal apparatus & their explanation

Dr. Hany
Waheeb

SUGGESTED TEXTBOOKS



1. Keith L. Moore: Before we are born, essentials of embryology and birth defects; 7th edition.
2. Langman: Medical embryology; 14th edition.
3. Web sites: https://studentconsult.inkling.com
   https://www.clinicalkey.com/student



BEST WISHES